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Recent studies employing an inductively coupled argon plasma system equipped with a torch capable of operating at pressures between 100 torr and 3000 torr will be described. Results from these studies indicate two major areas of research where non-atmospheric pressure torch conditions can be utilized.

The first of these areas is the elucidation of excitation and energy transfer mechanisms within the plasma. The effect of pressure on energy transfer mechanisms, electron densities and other excitation phenomenon will be discussed and evaluated in light of recent plasma models. Data demonstrating shifts in the relative concentrations of excited state and ground state species will be presented along with spacial mapping of excitation temperatures and ion-to-atom ratios within the plasma. Additional data to be presented will include relative emission intensities for atomic and ionic emissions originating from high and low energy transitions. Such data is important in predicting plasma deviation from local thermal equilibrium conditions. Results of studies indicating a shift of plasma conditions toward local thermal equilibrium with increasing pressure and the implications for theoretical (over)

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→ modeling of this trend will also be discussed.

In addition to improving our theoretical understanding of inductively coupled plasmas, non-atmospheric torch conditions may be utilized to improve the analytical performance of argon inductively coupled plasma atomic emission spectroscopy. Results from these studies will be presented showing the effect of torch pressure on the spatial distribution and relative intensities of atomic and ionic emissions for different analyte species introduced into the plasma. Since the size and shape of the plasma changes with torch pressure, these data are critical for selecting the proper viewing region in the plasma and choosing an appropriate emission line for analytical use. Sensitivity measurements, signal-to-noise ratios, and signal-to-background ratios will also be presented and considered in the evaluation of non-atmospheric operating conditions for analytical analysis. In summary, the practical implications of these studies on routine analysis, including the ability to obtain improved analytical performance, will be discussed.

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by

T.R. Smith and M.B. Denton

Prepared for Presentation at the
Pittsburgh Conference
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February 23, 1988

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THE EFFECT OF TORCH PRESSURE ON ANALYTE RESPONSE
IN A 27 MHZ INDUCTIVELY COUPLED PLASMA

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ABSTRACT

Recent studies employing an inductively coupled argon plasma system equipped with a torch capable of operating at pressures between 100 torr and 3000 torr will be described. Results from these studies indicate two major areas of research where non-atmospheric pressure torch conditions can be utilized.

The first of these areas is the elucidation of excitation and energy transfer mechanisms within the plasma. The effect of pressure on energy transfer mechanisms, electron densities and other excitation phenomenon will be discussed and evaluated in light of recent plasma models. Data demonstrating shifts in the relative concentrations of excited state and ground state species will be presented along with spacial mapping of excitation temperatures and ion-to-atom ratios within the plasma. Additional data to be presented will include relative emission intensities for atomic and ionic emissions originating from high and low energy transitions. Such data is important in predicting plasma deviation from local thermal equilibrium conditions. Results of studies indicating a shift of plasma conditions toward local thermal equilibrium with increasing pressure and the implications for theoretical modeling of this trend will also be discussed.

In addition to improving our theoretical understanding of inductively coupled plasmas, non-atmospheric torch conditions may be utilized to improve the analytical performance of argon inductively coupled plasma atomic emission spectroscopy. Results from these studies will be presented showing the effect of torch pressure on the spacial distribution and relative intensities of atomic and ionic emissions for different analyte species introduced into the plasma. Since the size and shape of the plasma changes with torch pressure, these data are critical for selecting the proper viewing region in the plasma and choosing an appropriate emission line for analytical use. Sensitivity measurements, signal-to-noise ratios, and signal-to-background ratios will also be presented and considered in the evaluation of non-atmospheric operating conditions for analytical analysis. In summary, the practical implications of these studies on routine analysis, including the ability to obtain improved analytical performance, will be discussed.

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